AUTOMOBILE TIRE SHOCK ABSORPTION MACHINE

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DESIGN, CONSTRUCTION AND OPERATION OF AN AUTOMOBILE TIRE SHOCK ABSORPTION MACHINE

A THESIS

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PREFACE

PREFACE

The development of the modern automobile may be attributed largely to the advances made in tire construction, as these members made it possible to drive automobiles at high speed over rough road surfaces without stressing the mechanism or causing discomfort to the passengers.

When the road is smooth and level as in a railway, the principal functions of the tire are to provide a hard, durable surface for the wheel, and to reduce to a minimum the resistance to rolling. But in bicycles, motor cars and other road vehicles in which freedom from vibration and shock from uneven road surface is desired, rubber or pneumatic tires are employed.

Therefore, the purpose of the tire is to absorb the shock due to irregularities in the road surfaces without transmitting much vibration to the frame of the vehicle. Their range of yield is, however, too limited to absorb the larger irregularities met with on rough roads, so that their use does not obviate the necessity of spring support of the carriage body on the wheel axles.

It has been shown by tests that a motor car equipped with large pneumatic tires and poor springs will suffer less shock from irregularities

that are met with, then the same car equipped with iron tired wheels and high grade springs.

Much research and experimental work has been and is being done in perfecting the tire of today, but comparatively nothing up to the present time has been constructed that will measure relative shock absorption of tires with any degree of accuracy and consistency.

It was with this idea in mind of securing such information that a tire machine was built, which will be described later in the treatise. It is hoped that from the analysis of the data, valuable information and perhaps theories in regard to automobile tires will be obtained.

We are much indebted to Professor George F. Gebhardt, and other members of faculty of the Mechanical Department at the Armour Institute of Technology, for their valuable assistance and guidance.

SCOPE

SCOPE

The present day tire is far from being a perfect shock absorber, although great steps have been taken towards this goal.

Theoretically, an elastic body will absorb all of the shock imposed upon it, and an inelastic body will absorb no shock. The automobile tire lies in between these two limits.

The amount of shock that a tire will absorb depends upon a number of vanables, such as, the load on the tire, the pressure of the air in the tire, the speed of the tire, the tractive effort produced by the tire, etc. During our experimenting we held certain factors constant for some runs and varied the other factors.

Due to the rolling resistance of the tire, as shown by the flattening out of the tire, that is, in contact with the road, and also to the force necessary to compress the tire due to a bump, there is a subsequent power loss.

The scope of this thesis is to correlate all the factors, and establish

relationships between them, so as to get the proper conditions for the tire to operate under for securing the best efficiency.

THEORY

THEORY

The large number of variables that enter into the problem, makes the theory underlying shock absorption of tires is very complex; but there are certain laws that hold true which enter into the theory.

The rolling resistance is due to actual sliding of the surfaces in contact. There is created a tendency to relative creeping motion between the tire and the surface upon which it rolls. Due to the slipping there is a subsequent expenditure of energy. The action causes the actual distance traversed by the tire to be different from the geometric distance calculated from the diameter and the number of revolutions of the wheel. A certain part of energy is expended in distorting the rubber between P and D of Fig. 1., part of this energy being restored in the rear portion of the tire as it passes over this and the rubber gets back to its original and unstrained state.

Fig. II shows a portion of the tire flattened out. P_1 and P_2 are the intensities of the pressures at points A_1 and A_2 at equal distances in front and behind C, the geometrical point of contact. P_1 opposes P_2 and

Fig. 1

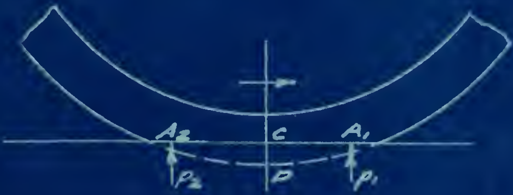


Fig. 2

Fig. 3

assists in the rolling of the wheel. At usual speeds the opposing force P_1 will be greater than the force of restitution P_2, the difference being a measure of the elastic hysteresis of the material that the tire is composed of, at that speed, which we will call R.

If the vertical compression C D of the tire is denoted by Y, then the energy loss is proportional to R Y. Call the energy loss E, then

E varies as R Y.

The higher the pressure in the tire the smaller would Y become. The harder the material the smaller R would be, as for example R is smaller for a steel tire than for a rubber tire. Therefore, the rolling resistance of a steel tire will be least; next in order comes the pneumatic tire inflated hard, then the pneumatic tire inflated soft, and last, with the greatest resistance the solid rubber tire.

Let a pneumatic tire inflated to p lbs. per square inch support a load of w lbs. The portion near the ground is flattened as in Fig. III

If the tire fabric is assumed to be perfectly flexible, then, since the part in contact with the ground is quite flat, the pressure, p and q on the opposite sides must be equal; that is, the tire presses upon the ground with an intensity of p lbs. per square inch. The area of the flattened surface is therefore, equal to $\frac{W}{p}$.

FIGURES IV to XI inclusive show the shapes of the areas of contact of a 30"x3½" V.S. plain tire under various loads and pressures, for different amounts of vertical flattening.

When the tire strikes a bump a peak is recorded on the chart due to the first impact. Due to the flexibility of the tire and the bumper pulley, when the tire falls there is a valley recorded on the chart. Due to the resilience of the tire there is another peak registered when the tire rebounds, and so on until the tire comes to rest as is shown on charts to follow.

When the tire passes over an obstruction, the walls of the tire, which are relatively light, will deffect inward and compress the air inside of the tire. A good shock ab-

sorbing tire will pass over the obstruction without any appreciable upward and downward movement. The shock absorption is inversely proportional to the height H, due to first impact. Theoretically, if the tire were a perfect shock absorber, the height H would become zero.

APPARATUS

THE MACHINE

REGULATION OF LOADING

REGULATION OF TRACTION EFFORT

DRIVING PULLEYS

IDLER PULLEYS FOR BUMP

RECORDING APPARATUS

ELECTRICAL EQUIPMENT

APPARATUS

THE MACHINE

The machine as originally designed is as shown in Fig. 12; with the exception of the recording apparatus, and the idle pulley for the bump. The machine was so constructed that the tire could be subjected to the same conditions as are met within actual road work.

The tire (A) is mounted on a standard wooden-spoked automobile wheel which is firmly attached to the shaft (B). This shaft rotates in three roller bearings (C) (D) and (F). The bearings (D) and (F) are rigidly connected to the frame (W), while bearing (C) is set in a block (X) which is free to move up and down between ball bearings in the slotted guides (E). A universal joint (H) is placed in the shaft to take care of the vertical motion due to irregularites. The main shaft (B) is driven by silent chain from a sprocket on the shaft (I) directly below it. The pulley or shaft (I) is driven by a belt from a countershaft pulley (Y), which is in turn driven by a belt from a 15 Horse-Power vanable speed motor. A clutch

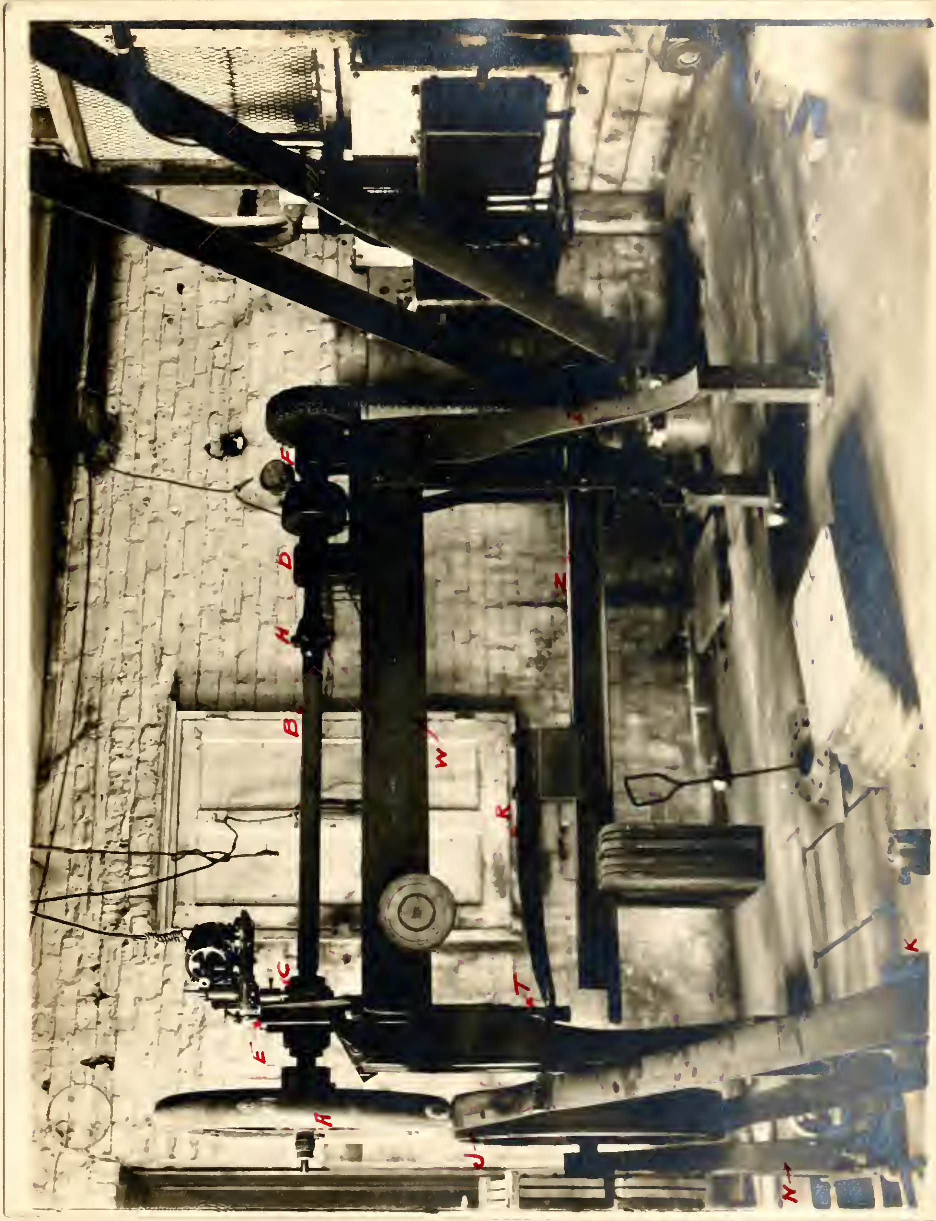


FIG. 12

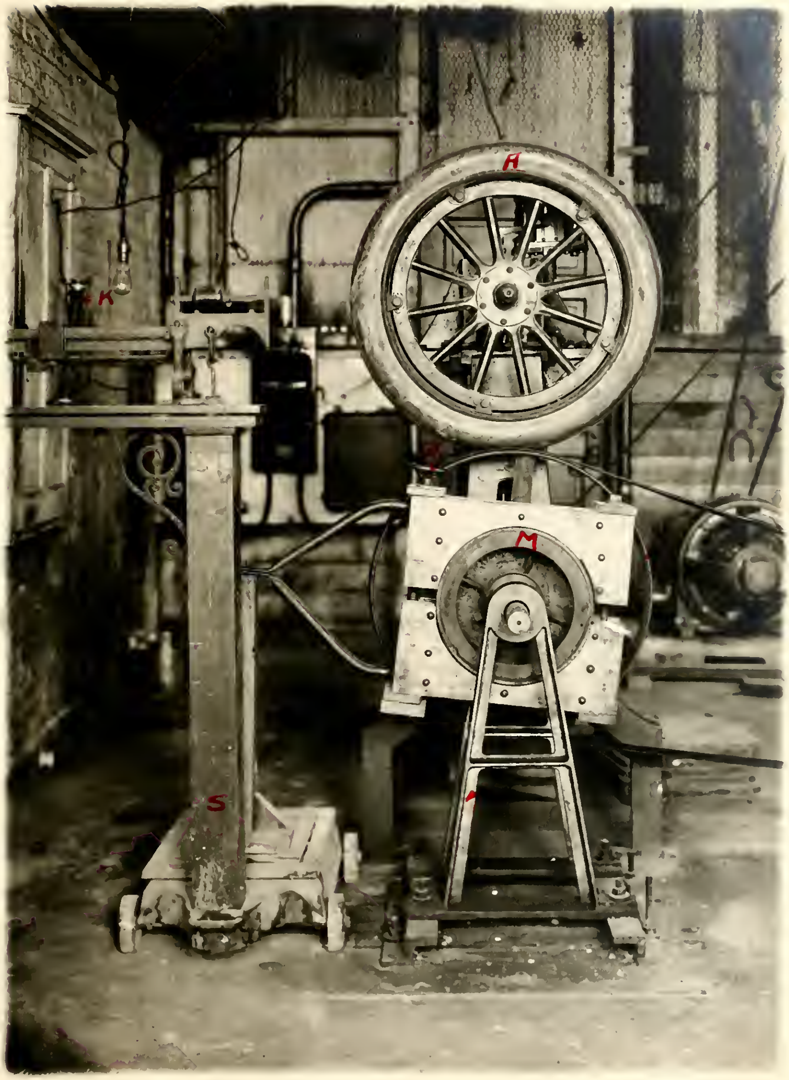


FIG 13

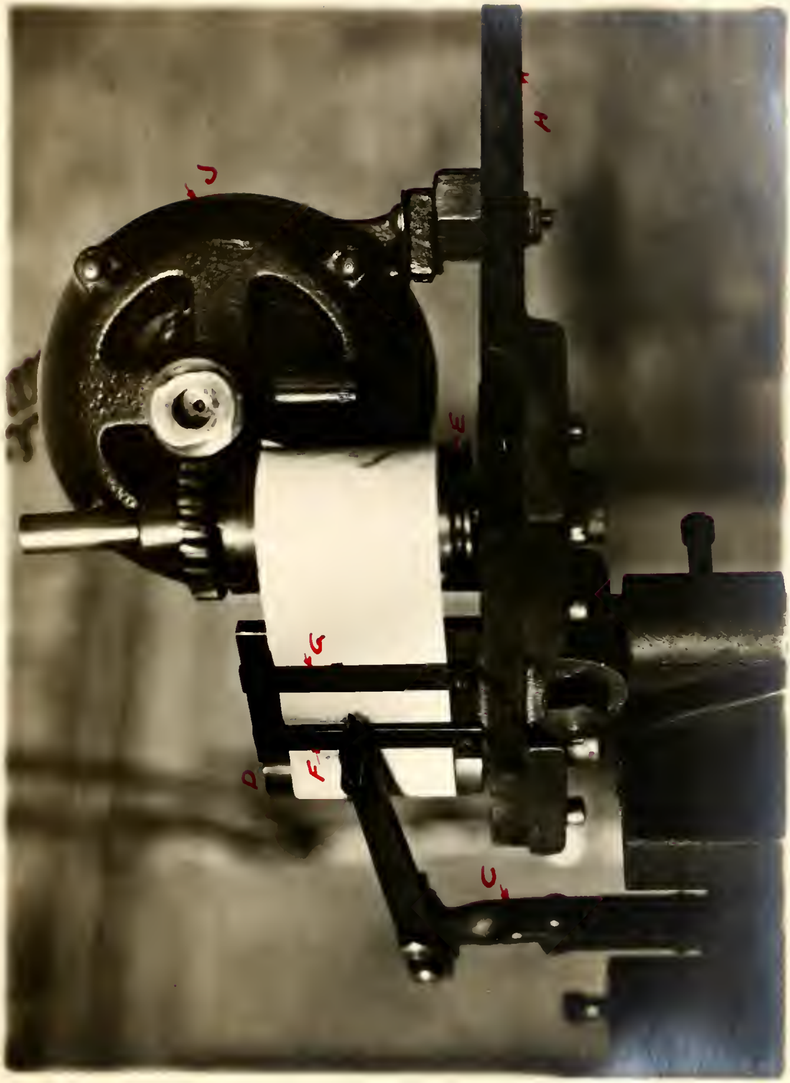


FIG. 14

is placed in the countershaft, so that the motor can be running without the machine operating.

REGULATION OF LOADING

The load on the tire is applied through a spring. The I-beam (Z) is suspended at one end by steel straps, while at the other end it is attached to heavy end of the cantilever spring (R). The other end of the spring is attached to a rod (T) which swings through universal joints from the bearing block (C). By slipping weights on or off of the I-beam, the load on the tire can be vaned to any desired amount.

REGULATION OF TRACTIVE EFFORT

A proxy brake was used to vary and measure the tractive effort Fig. 13 shows the tire resting on the belt which carries the bump and runs between the idler pulleys (J) and (K). The shaft that carries pulley (J) is mounted in roller bearings set in standard (N). The friction wheel (M) is keyed to this shaft between the standards, while the pulley (J) overhangs the end. The tractive effort is vaned by turning the hand wheel (q) which tightens or loosens the brake

thereby increasing or decreasing the tractive effort which is measured by the scale (S).

DRIVING PULLEYS

It was desired to rotate the tire at a speed which is concordant with the practical use of the tire. Fig 15 is a diagramatic sketch of the driving arrangement.

G - Pulley	5"	Diameter	5" Face.
H - Pulley	16"	"	6" "
L - Pulley	20"	"	6" "
O - Pulley	12"	"	5½" "
U - Sprocket	5" P.D.		3½" "
V - Sprocket	10" P.D.		3½" "

With this arrangement speeds up to forty-five miles per hour were obtainable.

IDLER PULLEYS FOR BUMP

The idler pulley (J) is twenty-seven inches in diameter and four inches wide. The other idler pulley (K) was mounted on the floor at a distance of seven feet from pulley (J). It is eleven inches in diameter and five and three-eighths inches wide. A shaft and bushing as on plate I was made. The bump was made of hard wood and was three-quarter inches high, two and three-quarters inches wide and three inches long as in Fig. 13. The bump was laced

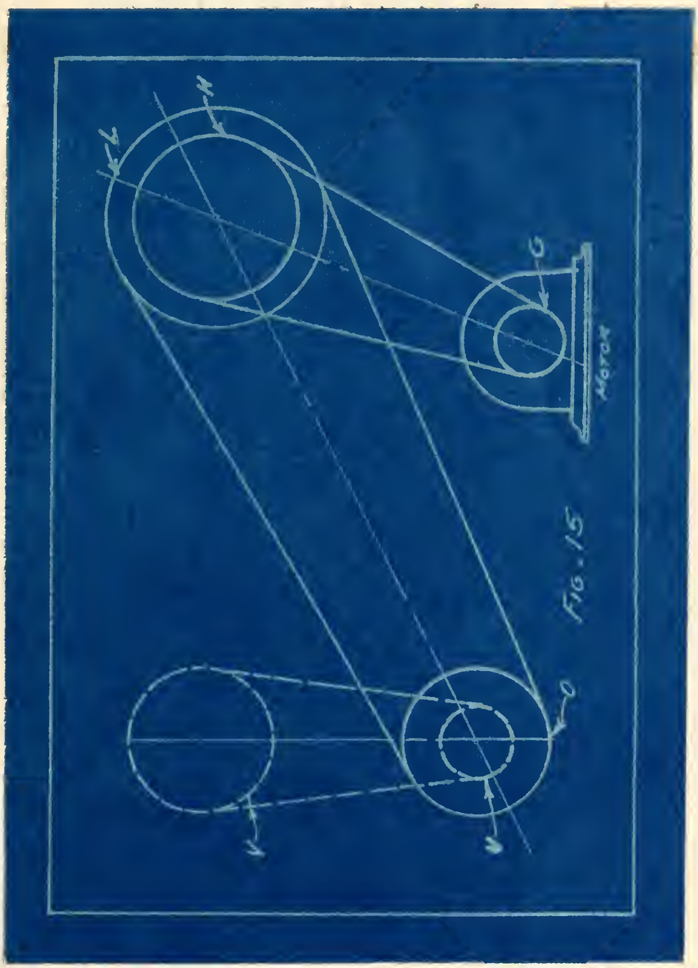


FIG. 15

onto the belt with wire lacing where the belt ends join so as not to give two projections, one from the bump and the other from the lacing. The belt is of raw-hide, three inches wide.

RECORDING APPARATUS

The recording apparatus is a vital organ of the test machine. Correct results can only be achieved by having the proper recording apparatus. Due to the fact that the device must be positive in action and also easily operated, the authors used a separate motor to run it. Previous to this arrangement, the recorder was operated by friction from shaft (B). This method was very unsatisfactory, being very unreliable in its action, and the device was changed as in Fig. 14.

The bearing block (C) has the pointer-arm Plate I attached to it by means of the arm support (C), which is shown on Plate III. At the end of the pointerarm is the pencil proper which is a brass point which records on metallic paper that was used. The two brass rollers (D) and (E) are mounted on a stand (F). Roller (D) is free to rotate while roller (E) is driven by means of a worm and gear from an electric motor (J) with a speed

reduction of 10 to 1. The metallic paper is wound on D and an end started on (E). When the motor is started the paper unwinds from roller (D) and winds up on roller (E). The paper passes under the pencil against a back to hold it rigid. It also passes under the brass strips (F) and (G) to keep it from moving up and down due to vibration and also the motion of the pointer. The driving motor is mounted on the platform (H) also shown on Plate II which was bolted to the stand (F). The speed of the motor is controlled by a rheostat (K) placed in series in the line.

As the pencil moves up and down due to the bumping and the paper moves due to the motor, a curve is recorded. The motion of the pencil in the previously constructed recording apparatus, was increased by means of a pantograph motion. This was unsatisfactory as well as not necessary, so it was done away with. In the present construction the motion of the pencil is neither increased or decreased, but is exactly as the motion of the wheel axle.

ELECTRICAL EQUIPMENT

The machine is run by a vanable speed 110 volt D.C. motor. Maximum power developed in 15 horsepower. The motor is controlled by a controller similar to those used on street railways. There is also a starting rheostat and a quick break knife-switch placed in the line.

The recording apparatus is run by a 1/12 horsepower, 110 volt, D.C. shunt motor having a maximum speed of 1728 R.P.M. The speed of the motor is controlled by a slide type resistance (K), and in this way vaned speeds are obtainable.

METHOD OF PROCEDURE

METHOD OF PROCEDURE

The method of procedure is as follows:-

The machine is set up under certain conditions, the machine is then started and the recording instrument turned on and a set of curves recorded.

As an example in our first run we had a static load (W) on the tire, a certain pressure (p) in the tire. The switch was thrown in and the machine put in operation. The load on the brake shaft was then set for a constant tractive effort. The motor of the recording apparatus was set into motion and a curve was obtained. This constitutes a run. Then with all of the above held constant, the speed was increased and another curve was obtained. This was repeated until the maximum speed of the motor was reached.

Then repeat the set of runs as described above varying the static load, (W) on the tire. The other factors are kept constant once more and with variation of speed another complete set of curves are attained. When the maximum load has been reached, the pressure of the tire is changed and the same

operation as has been described, was adhered to.

The following data was taken:-

Speed of tire	(RPM)
Static Load on Tire	(W)
Pressure in Tire	(p)
Brake Load	(L)

TRACTION SPOTS

To obtain the static load W on the tire raise the wheel by means of a cable and scale fastened to the hub and read the scale. This will give directly the true load (W) on the tire.

The speed of the wheel was secured by means of a tachometer.

The pressure of the air in the tire is secured by a tire pressure gauge.

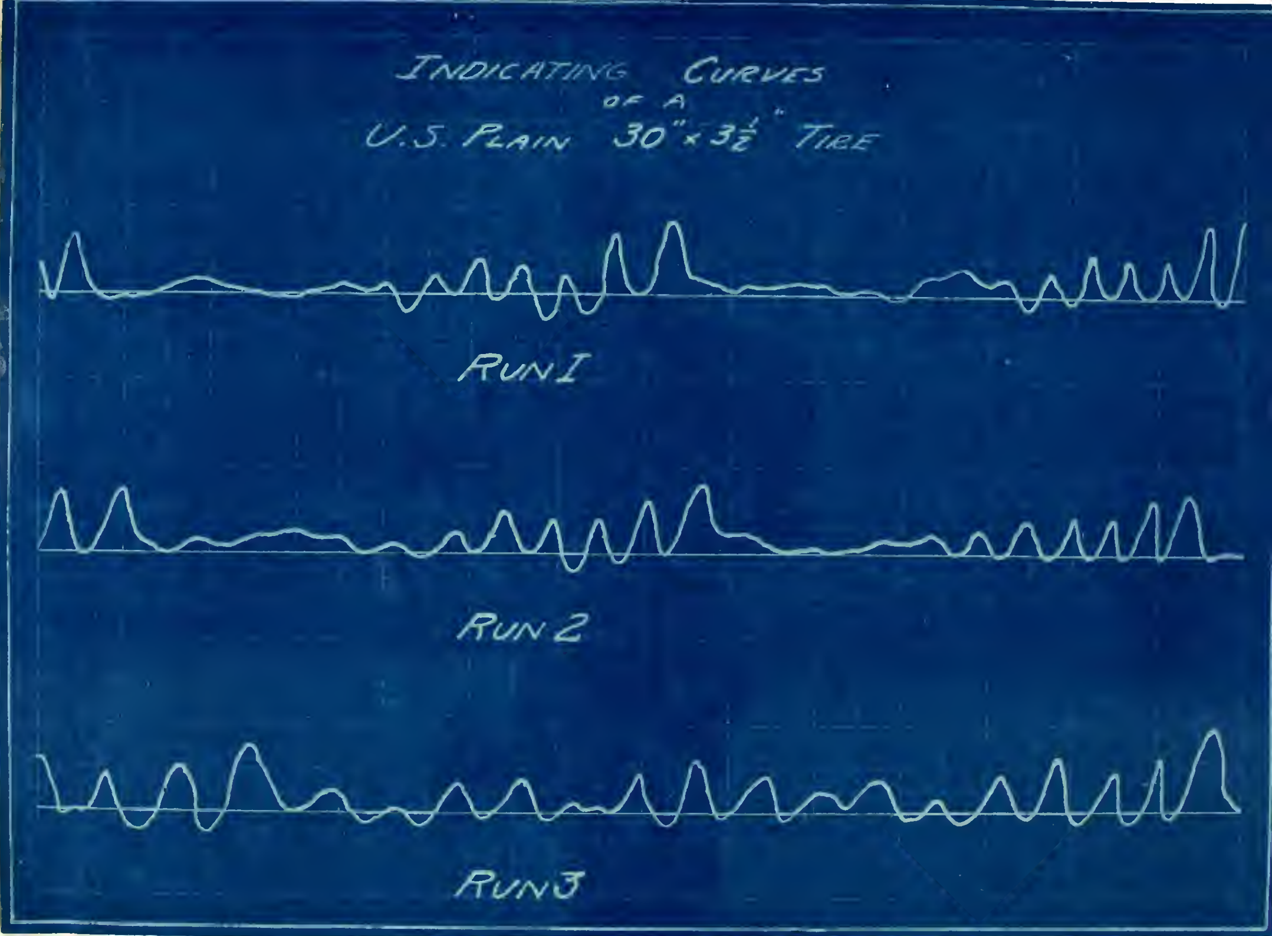
The traction spots were obtained under various loads (W) and varied pressure (p) as shown in Figs. 4 to 11 incl. To get the traction spot, cover a flat board with chalk dust,

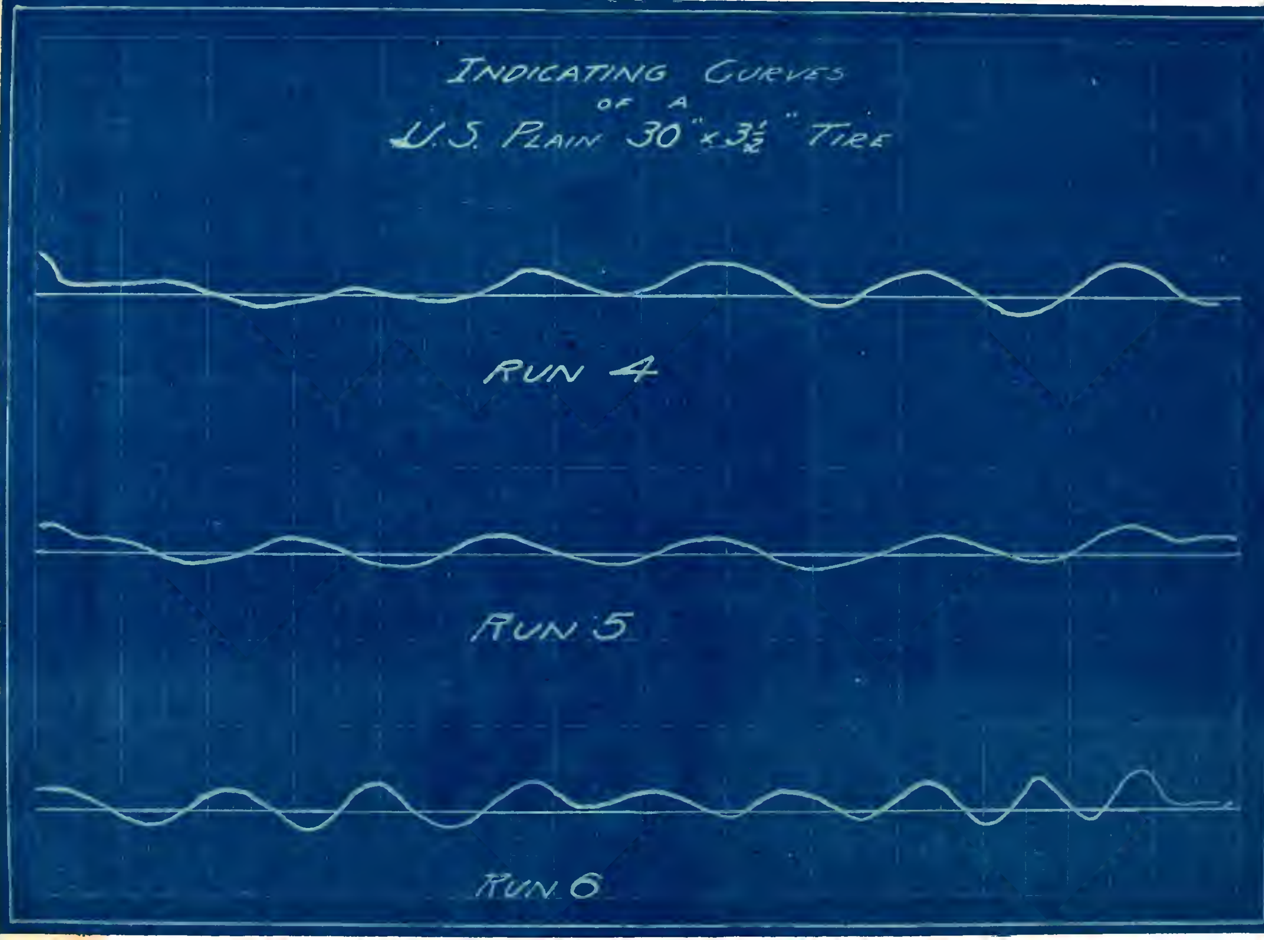
And moisten the tire. Allow the tire to come down in contact with the board and an imprint will be made upon the board. This imprint is a true representation of the traction spot and is then traced upon paper.

The speed of the paper,which is controlled by rheostat is determined by measuring the distance between peaks, the distance the bump travels and the speed of the bump.

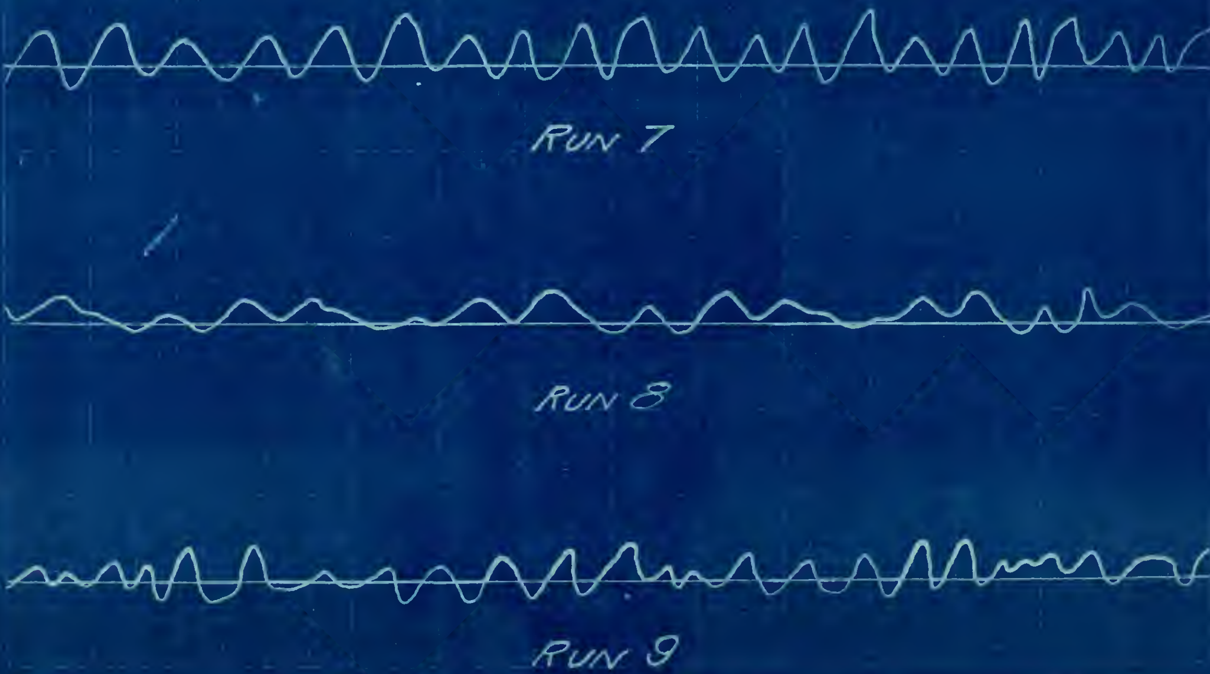
CURVES AND DATA

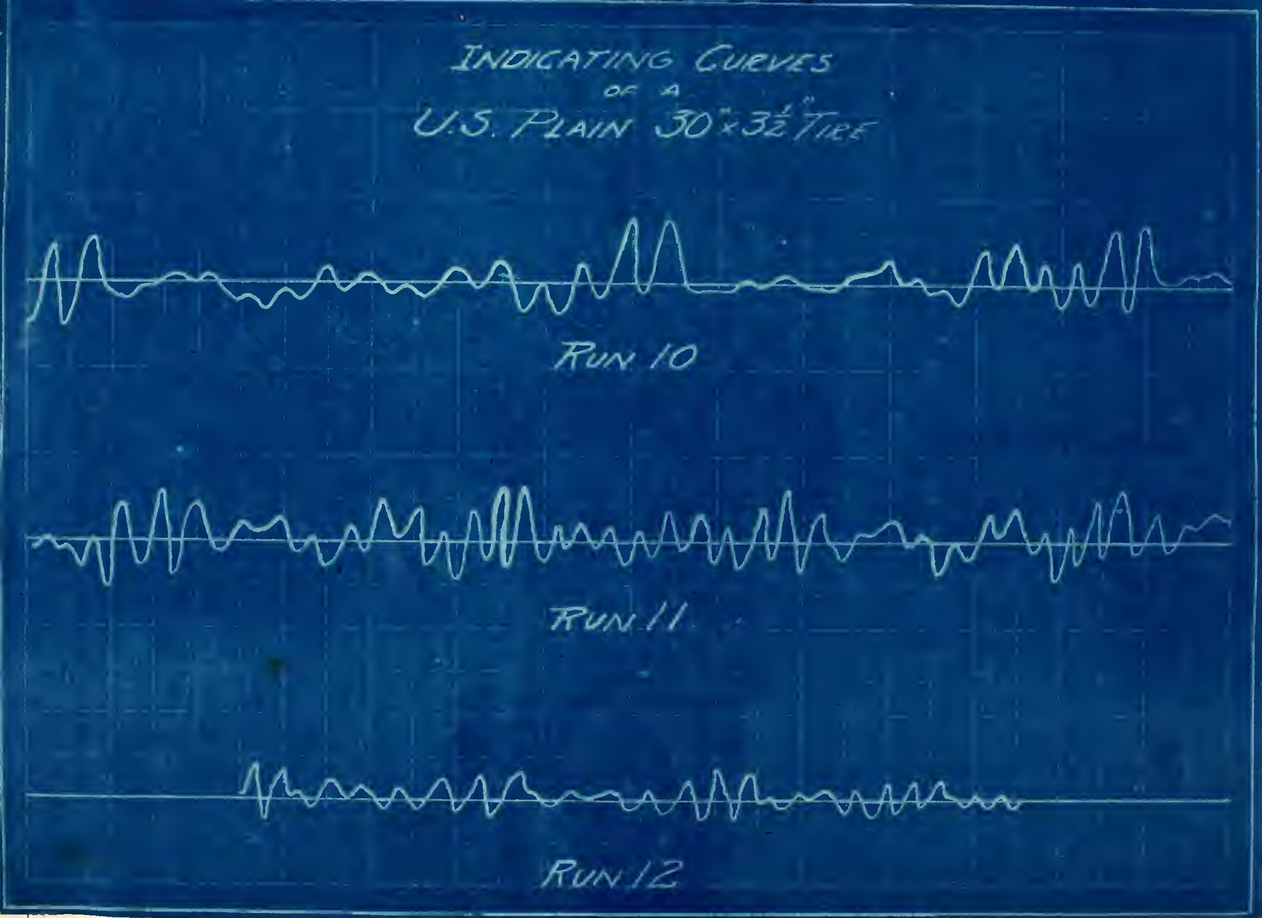
INDICATING CURVES

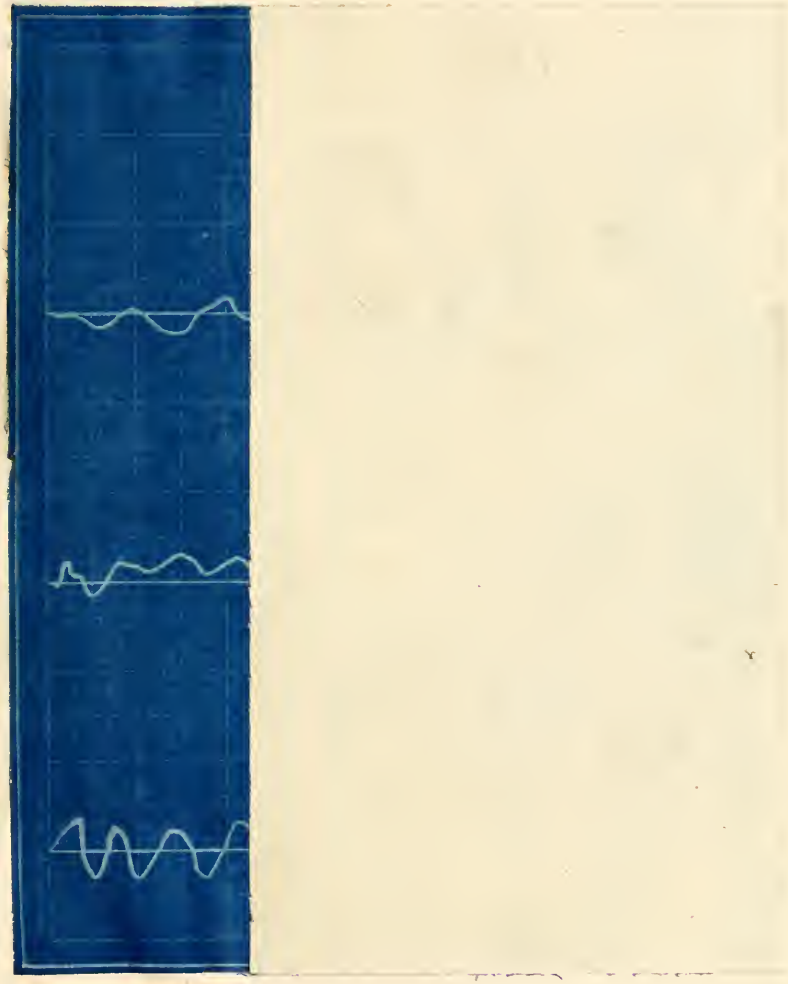

INDICATING CURVES
OF A
U.S. PLAIN 30"×3½" TIRE
RUN I
RUN 2
RUN 3

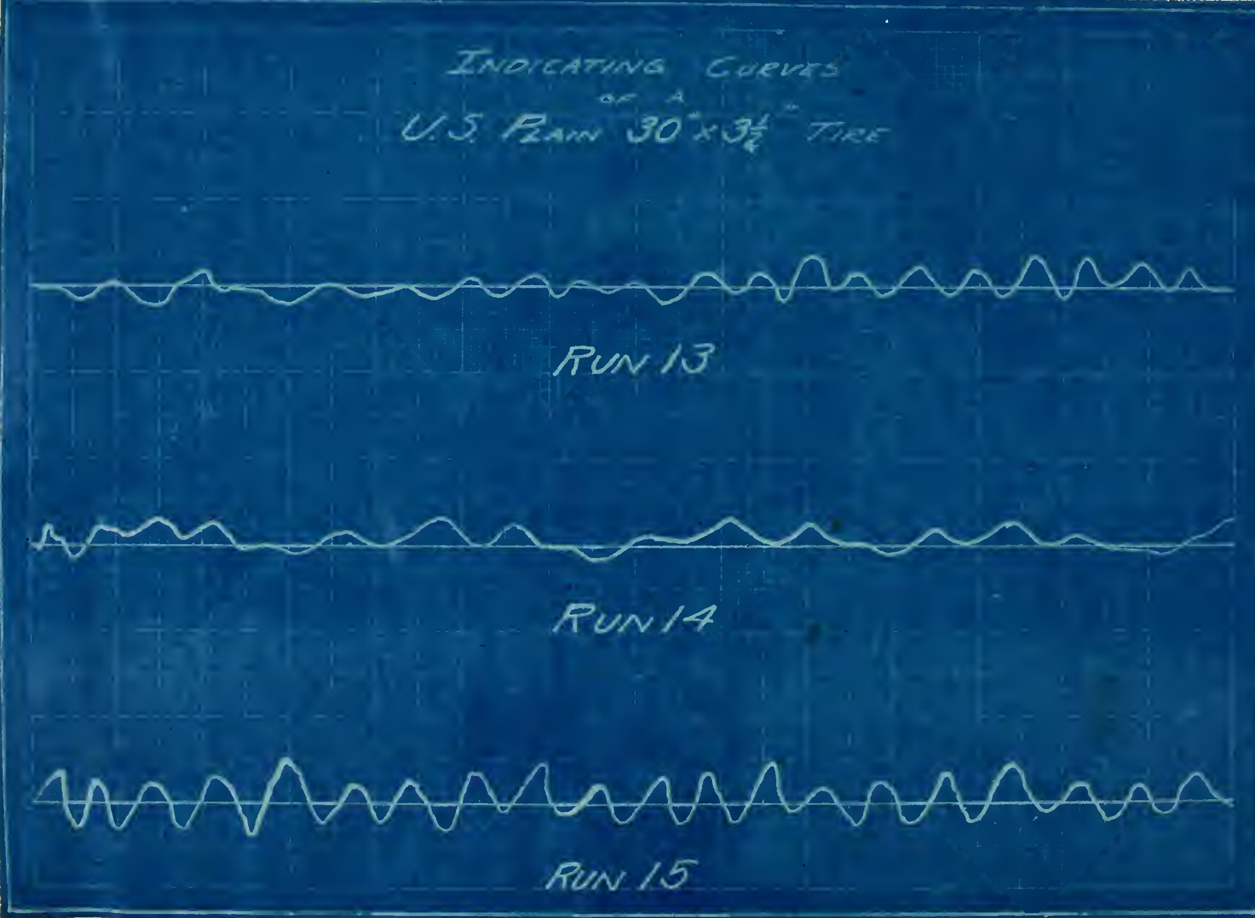

INDICATING CURVES
OF A
U.S. PLAIN 30" × 3½" TIRE
RUN 4
RUN 5
RUN 6

INDICATING CURVES OF A U.S. PLAIN 30"×3½" TIRE

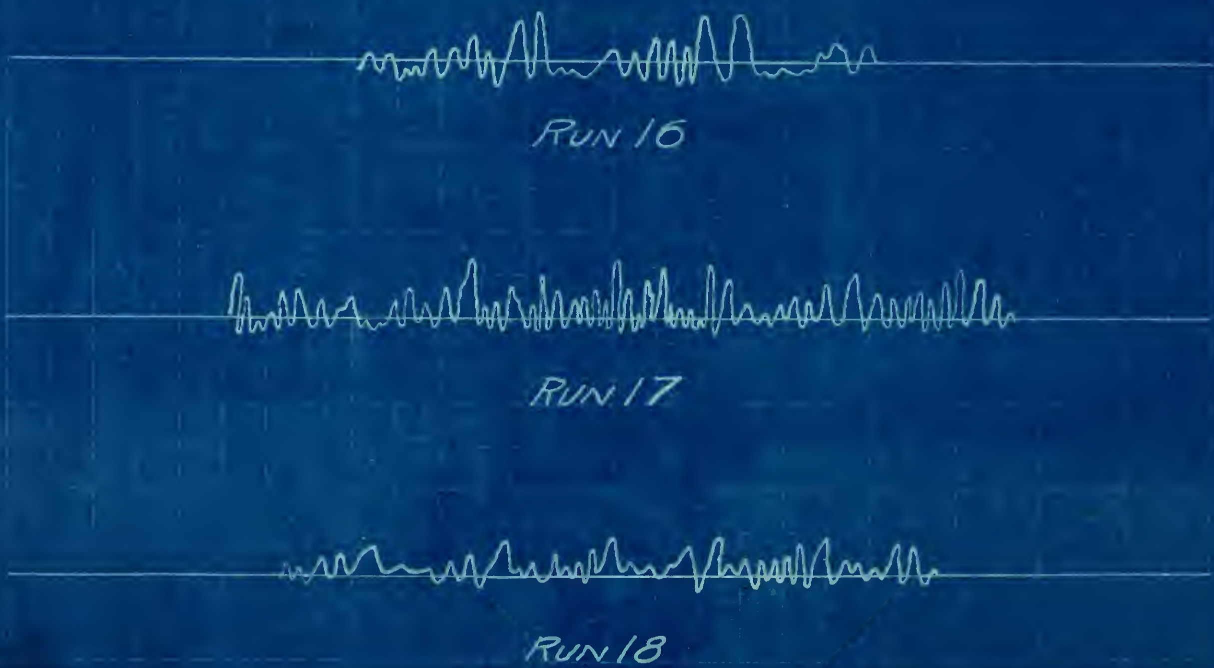



INDICATING CURVES
OF A
U.S. PLAIN 30" × 3½" TIRE
RUN 10
RUN 11
RUN 12

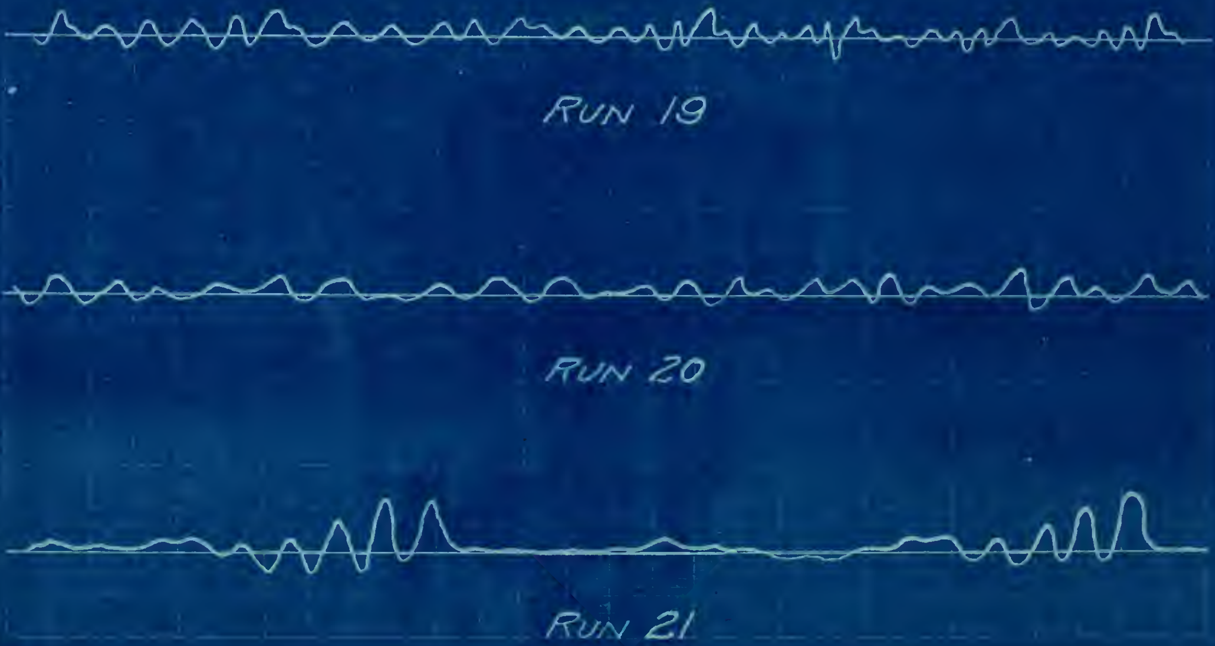


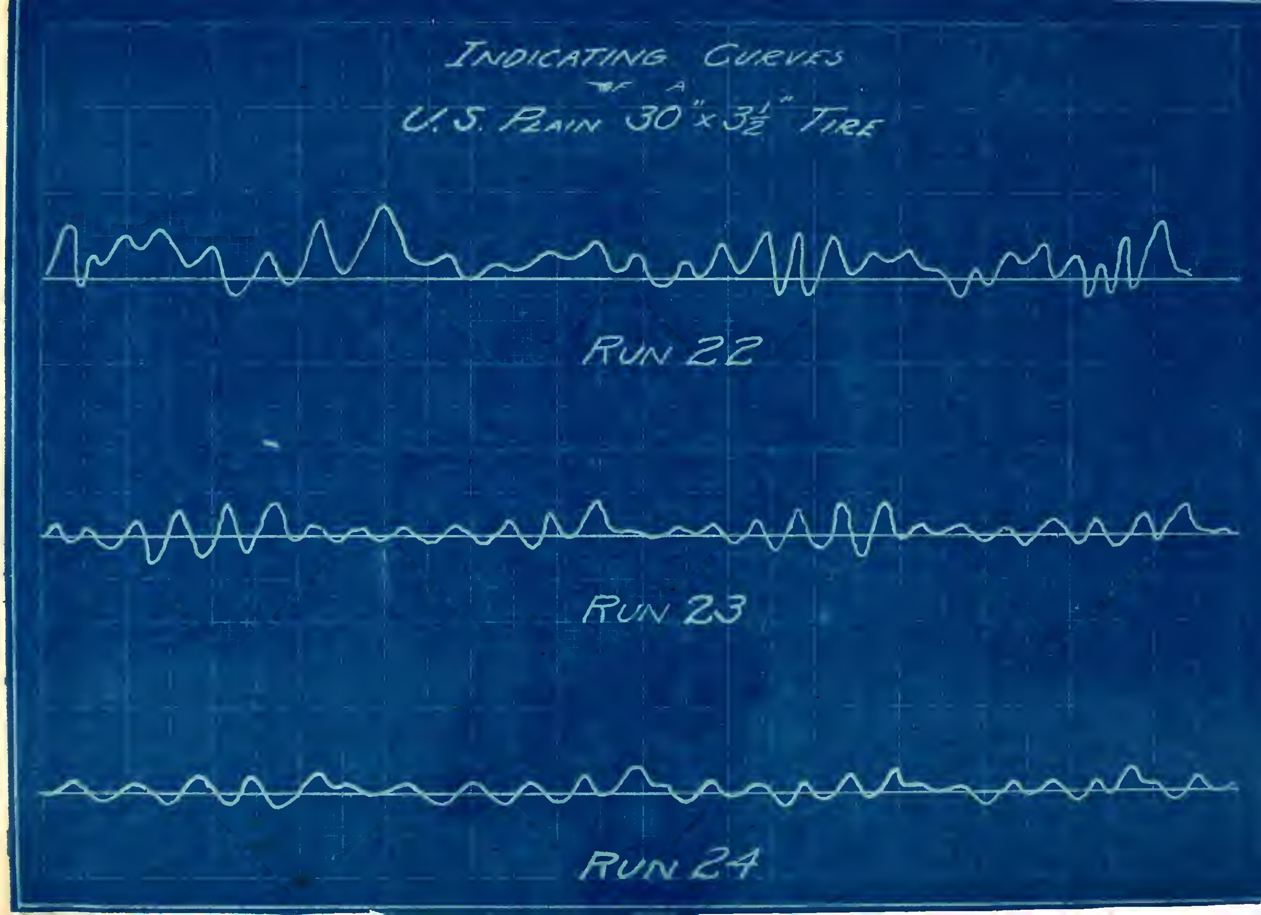

INDICATING CURVES
OF A
U.S. PLAIN 30" x 3½" TIRE
RUN 13
RUN 14
RUN 15

INDICATING CURVES OF A U. S. PLAIN 30" x 3½" TIRE

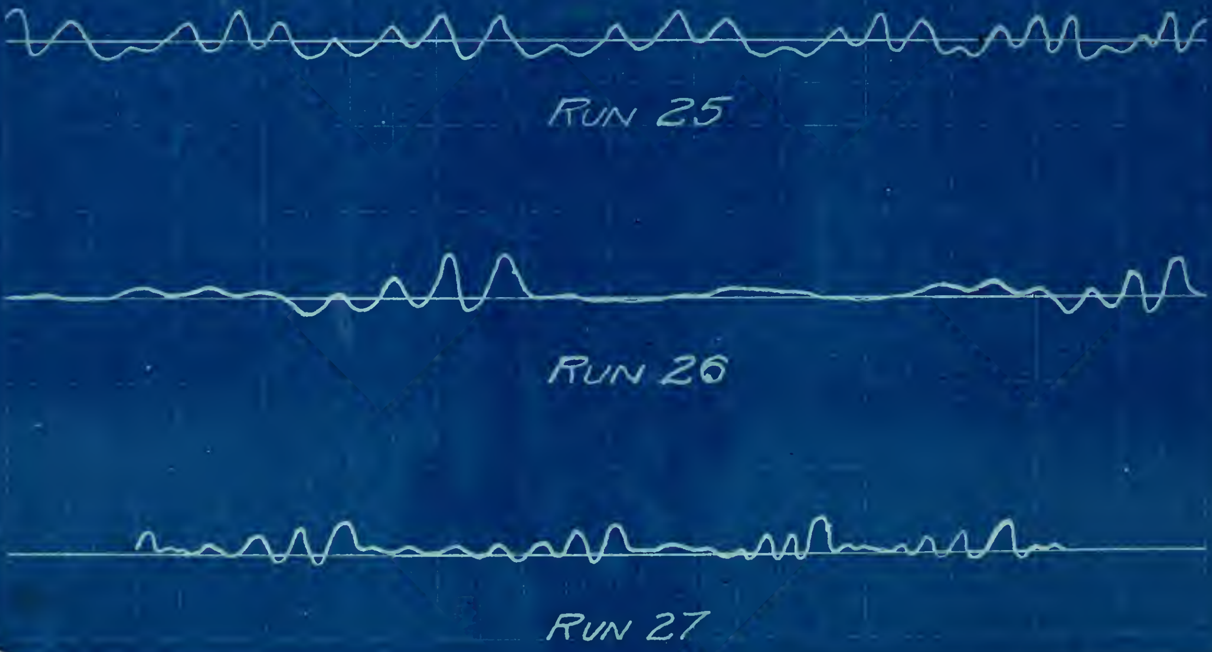


INDICATING CURVES OF A U.S. PLAIN 30" x 3½" TIRE.



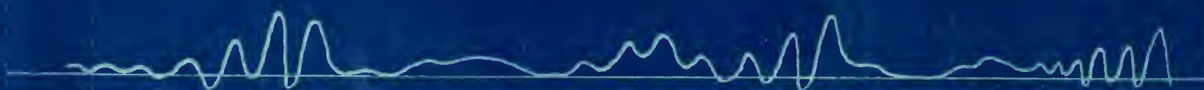

INDICATING CURVES
OF A
U.S. PLAIN 30" x 3½" TIRE
RUN 22
RUN 23
RUN 24

INDICATING CURVES
OF A
U.S. PLAIN 30" x 3½" TIRE



INDICATING CURVES
OF A
U.S. PLAIN 30" x 3½" TIRE

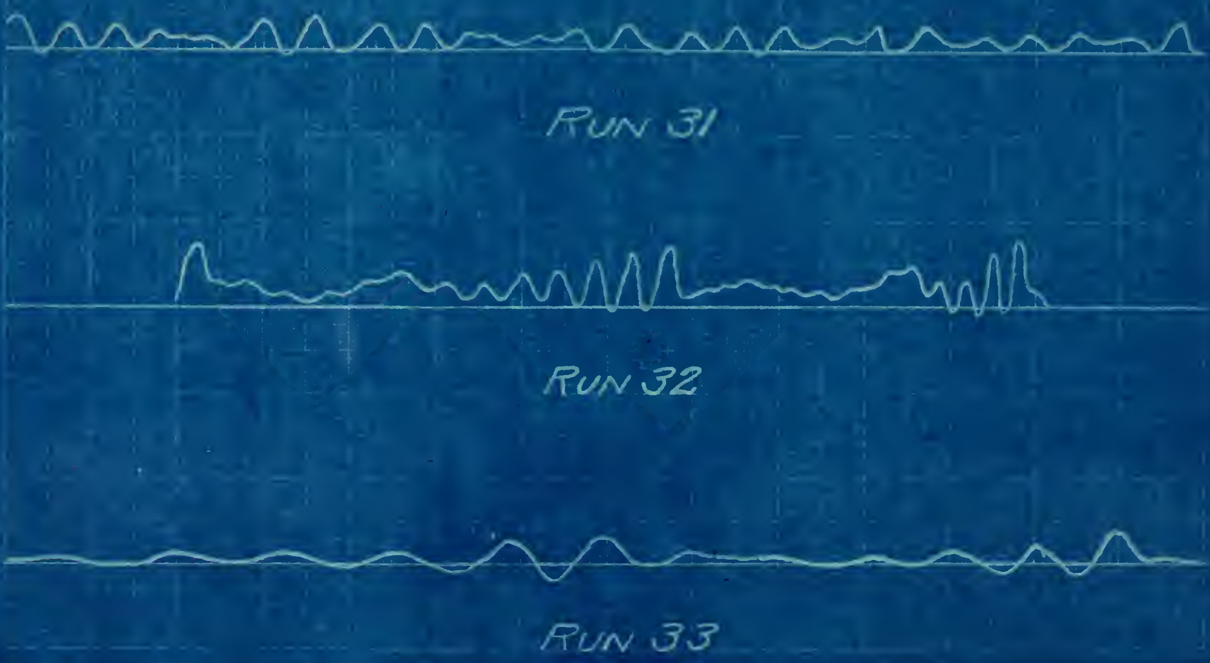
RUN 28

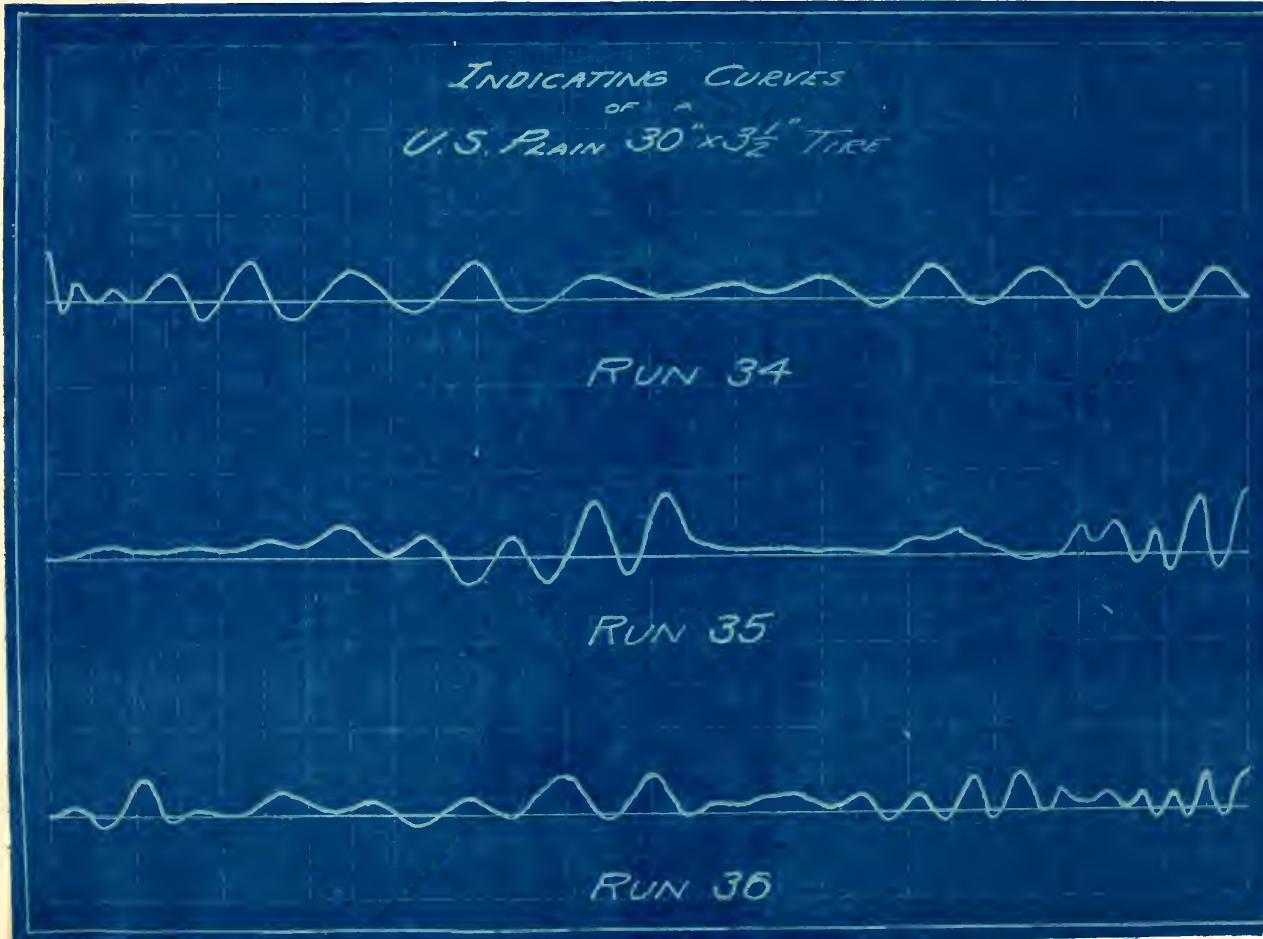


RUN 29

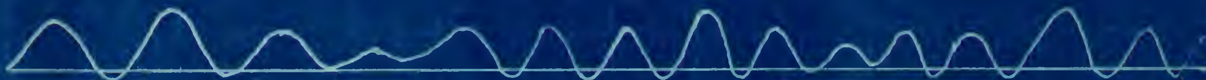
RUN 30

INDICATING CURVES OF A U.S. PLAIN 30" x $3\frac{1}{2}$" TIRE



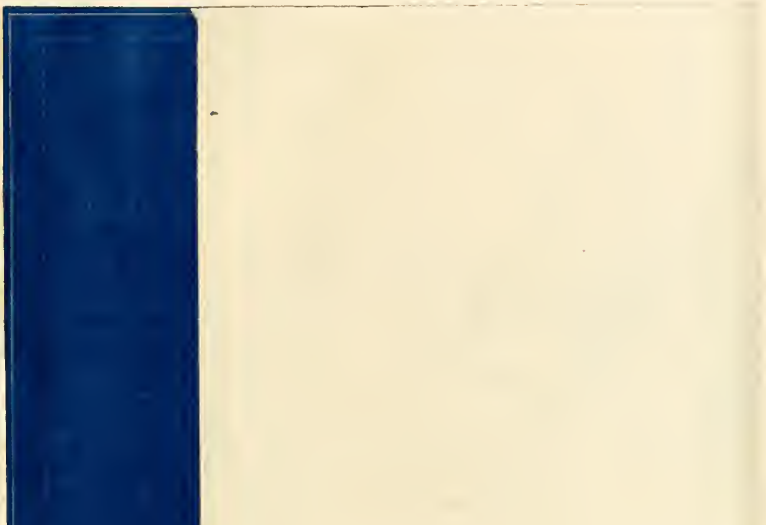

INDICATING CURVES
OF A
U.S. PLAIN 30"x3½" TIRE
RUN 34
RUN 35
RUN 36

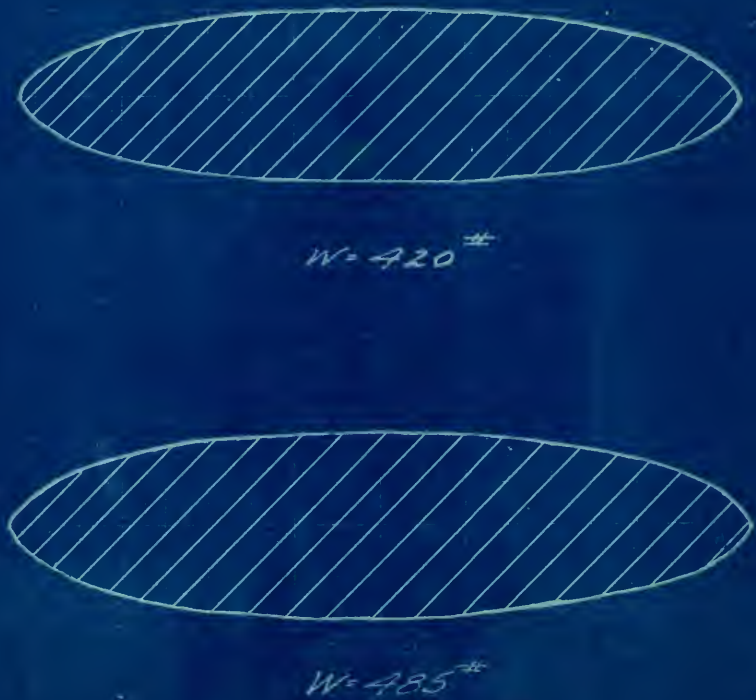
INDICATING CURVE
OF A
U.S. PLAIN 30" x 3½" TIRE



RUN 37

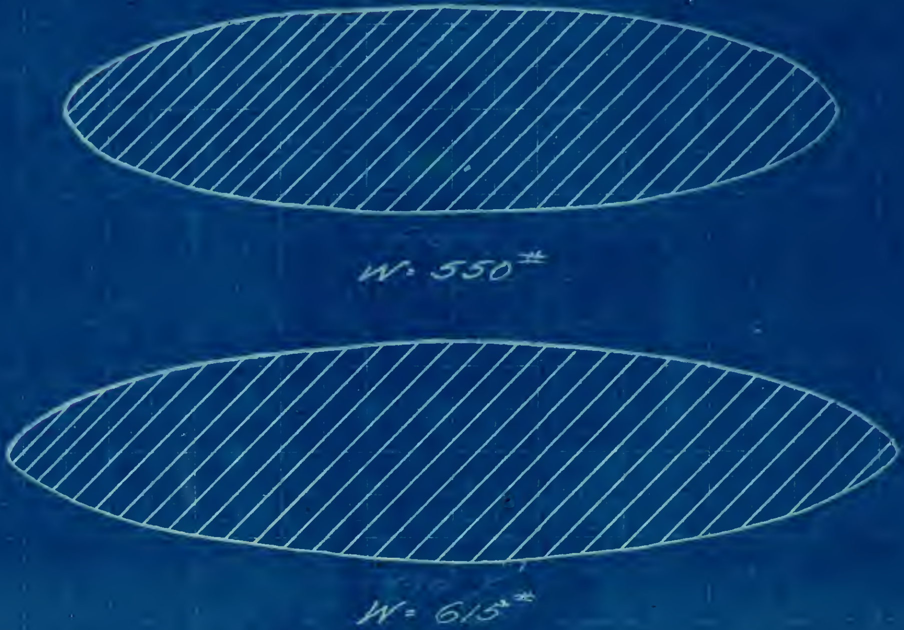
TRACTION SPOTS


TRACT

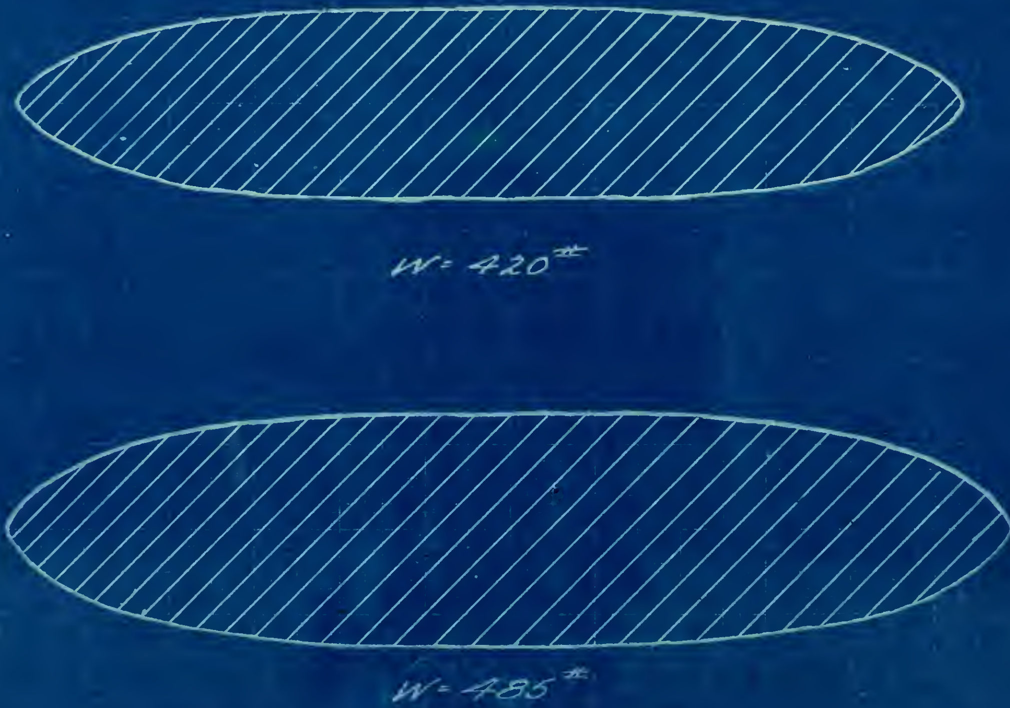


TRACTION SPOTS OF A U.S. PLAIN 30" x 3½" TIRE 60# PRESSURE

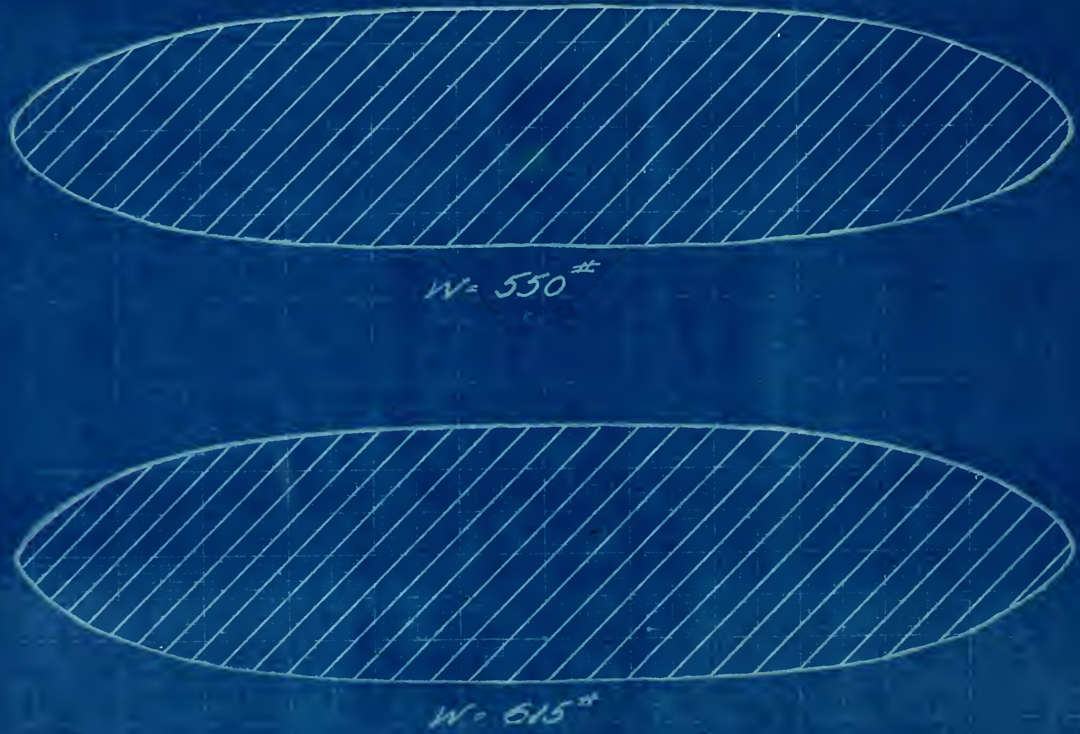

TRACT



TRACTION SPOTS OF A U.S. PLAIN 30" x 3½" TIRE 60# PRESSURE



TRACTION SPOTS OF A U.S. PLAIN 30" x $3\frac{1}{2}$" TIRE   35# PRESSURE



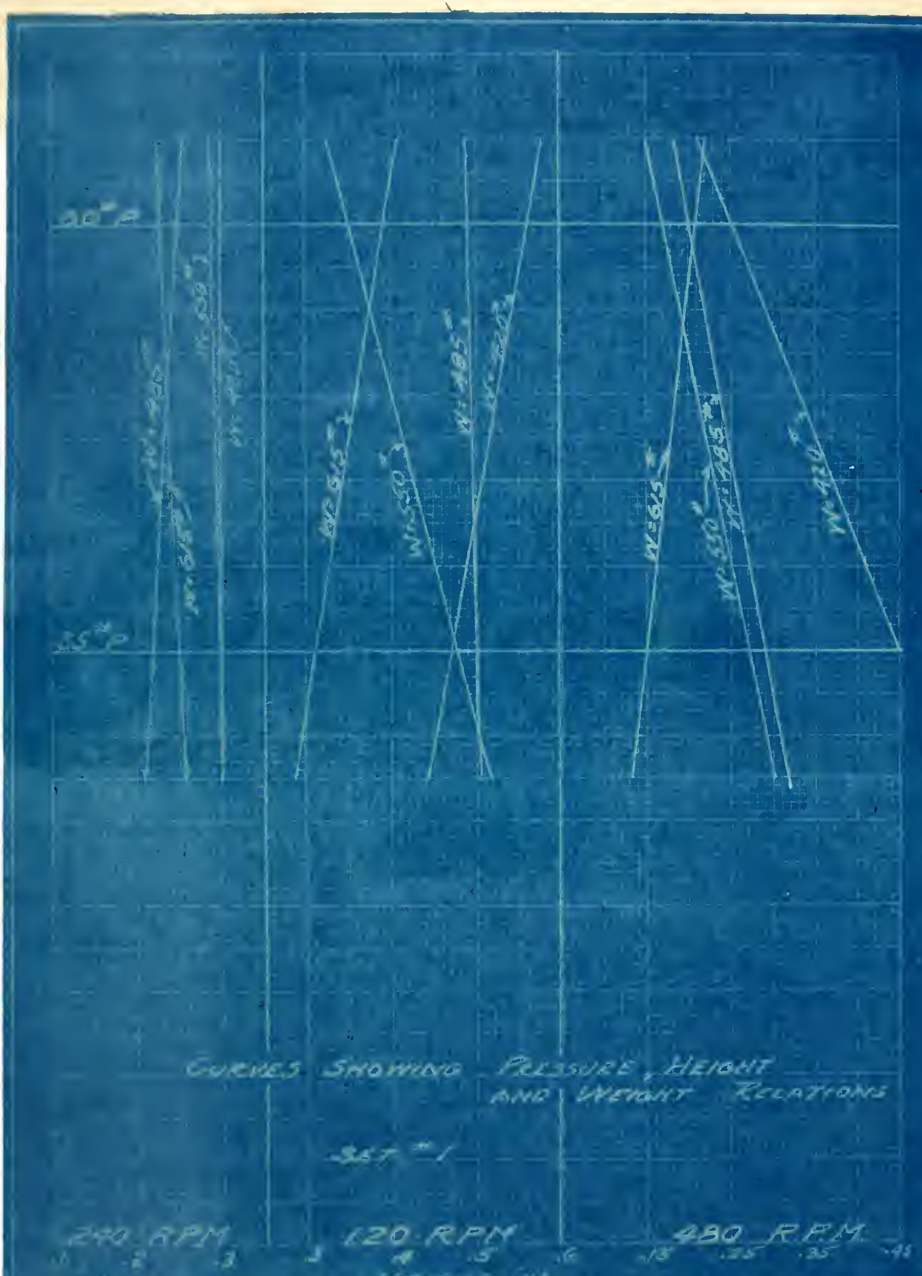
TRACTION SPOTS OF A U.S. PLAIN 30" x 3½" TIRE 35# PRESSURE

DATA

RUN	BRAKE SHAFT		TIRE			TRACTION SPOT			[illegible]
	R.P.M.	GROSS LOAD	MILES PER HR.	PRESSURE #/□"	LOAD (W)#	LENGTH	WIDTH	AREA	
1	117	20#	10.45	60	420	5.25	1.25	5.35	.56

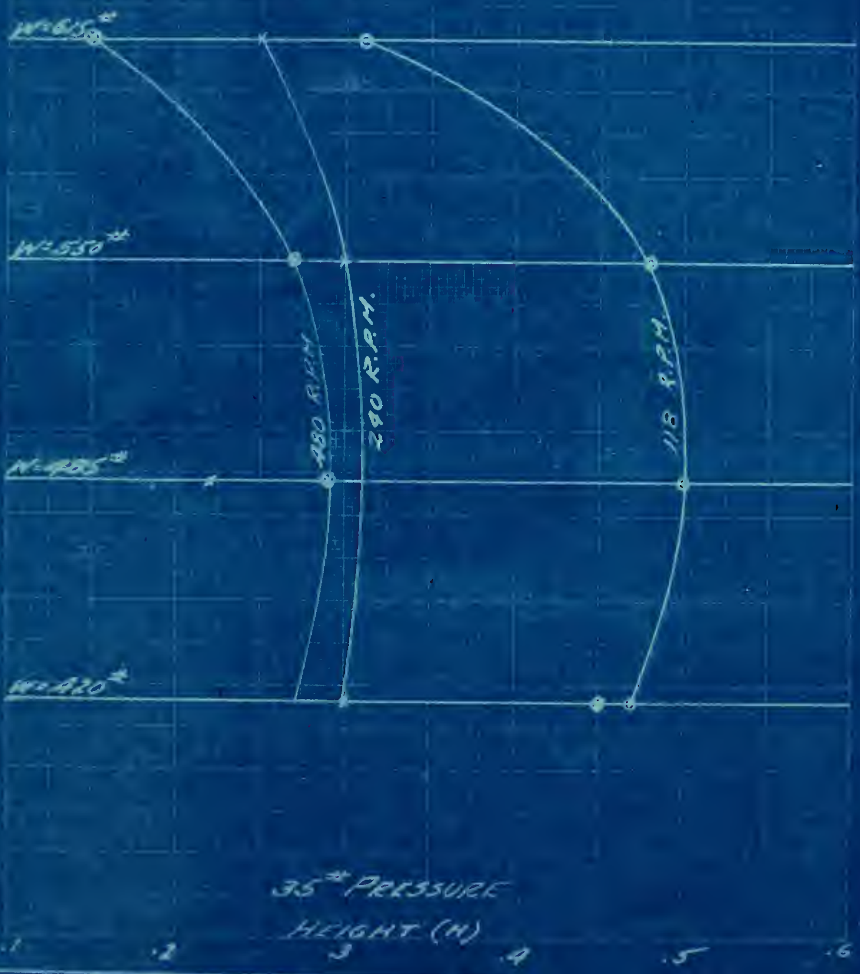
RUN	BRAKE SHAFT		TIRE			TRACTION		SPOT	[illegible]
	R.P.M.	GROSS LOAD	MILES PER HR.	PRESSURE #/□"	LOAD (W)#	LENGTH	WIDTH	AREA	
1	117	20#	10.45	60	420	5.25	1.25	5.35	.56
2	145	20#	12.95	60	420	5.25	1.27	5.35	.50
3	200	20#	17.90	60	420	5.25	1.25	5.35	.61
4	250	20#	22.35	60	420	5.25	1.25	5.35	.30
5	300	20#	26.8	60	420	5.25	1.25	5.35	.20
6	350	20#	31.30	60	420	5.25	1.25	5.35	.20
7	400	20#	35.7	60	420	5.25	1.25	5.35	.40
8	485	20#	43.3	60	420	5.25	1.25	5.35	.25
9	300	40#	26.8	60	420	5.25	1.25	5.35	.29
10	118	20#	10.46	60	485	5.42	1.37	5.95	.49
11	170	20#	15.20	60	485	5.42	1.37	5.95	.40
12	240	20#	21.45	60	485	5.42	1.37	5.95	.25
13	350	20#	31.30	60	485	5.42	1.37	5.95	.22
14	470	20#	42.0	60	485	5.42	1.37	5.95	.20
15	400	30#	35.7	60	485	5.42	1.37	5.95	.30
16	118	20#	10.46	60	550	5.65	1.50	6.74	.35
17	160	20#	14.3	60	550	5.65	1.50	6.74	.43
18	240	20#	21.45	60	550	5.65	1.50	6.74	.29
19	320	20#	28.6	60	550	5.65	1.50	6.74	.20
20	430	20#	38.4	60	550	5.65	1.50	6.74	.17
21	118	20#	10.46	60	615	6.50	1.62	7.78	.39
22	160	20#	14.3	60	615	6.50	1.62	7.78	.53
23	240	20#	21.45	60	615	6.50	1.62	7.78	.23
24	315	20#	28.2	60	615	6.50	1.62	7.78	.19
25	400	20#	35.7	60	615	6.50	1.62	7.78	.21
26	118	20#	10.46	35	615	7.78	1.87	8.07	.31
27	240	20#	21.45	35	615	7.78	1.87	11.90	.35
28	460	20#	41.1	35	615	7.78	1.87	11.90	.15
29	120	20#	10.7	35	550	7.77	1.75	11.45	.48
30	240	20#	21.45	35	550	7.77	1.75	11.45	.30
31	465	20#	41.5	35	550	7.77	1.75	11.45	.27
32	119	20#	10.6	35	485	7.37	1.72	10.55	.50
33	240	20#	21.45	35	485	7.37	1.72	10.55	.22
34	465	20#	41.5	35	485	7.37	1.72	10.55	.29
35	120	20#	10.7	35	420	6.95	1.45	11.90	.47
36	240	20#	21.45	35	420	6.95	1.45	8.07	.30
37	475	20#	42.5	35	420	6.95	1.45	8.07	.45

CURVES

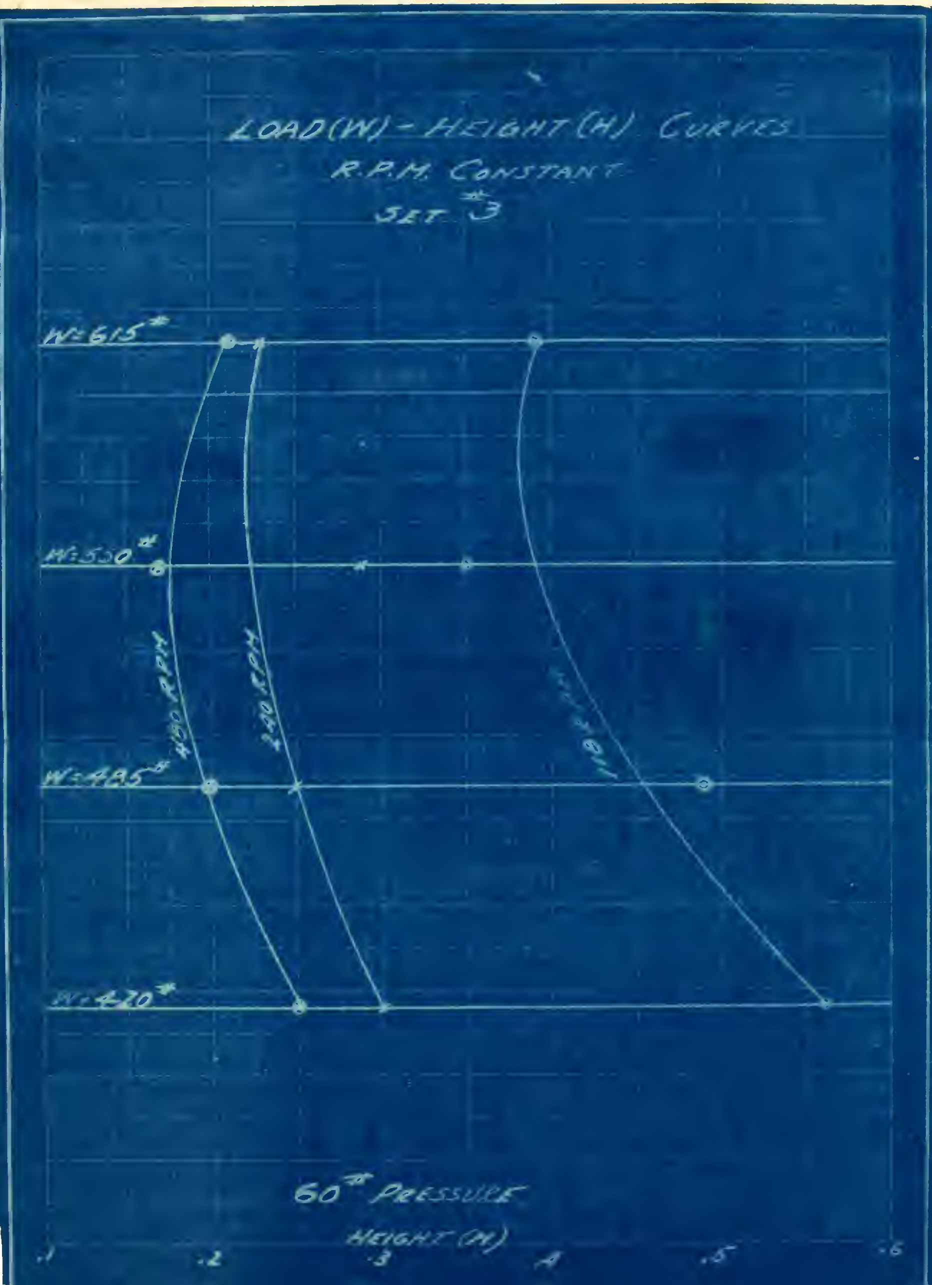

40# P
35# P
W=615#
W=550#
W=485#
W=420#
CURVES SHOWING PRESSURE, HEIGHT AND WEIGHT RELATIONS
SET #1
240 R.P.M.
120 R.P.M.
480 R.P.M.

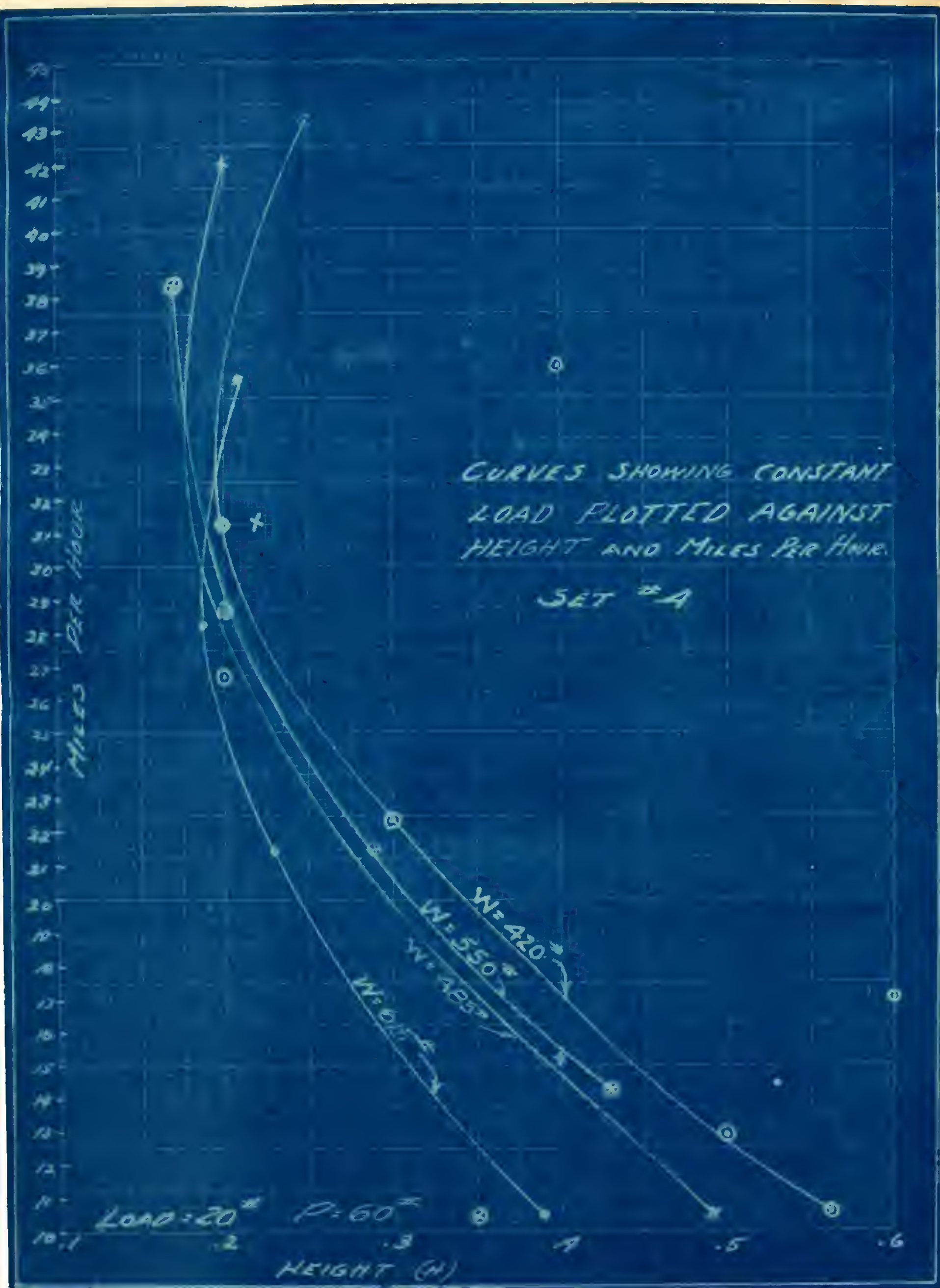

LOAD(W) - HEIGHT(H) CURVES
R.P.M. CONSTANT

LOAD (W) - HEIGHT (H) CURVES
R.P.M. CONSTANT
SET #2

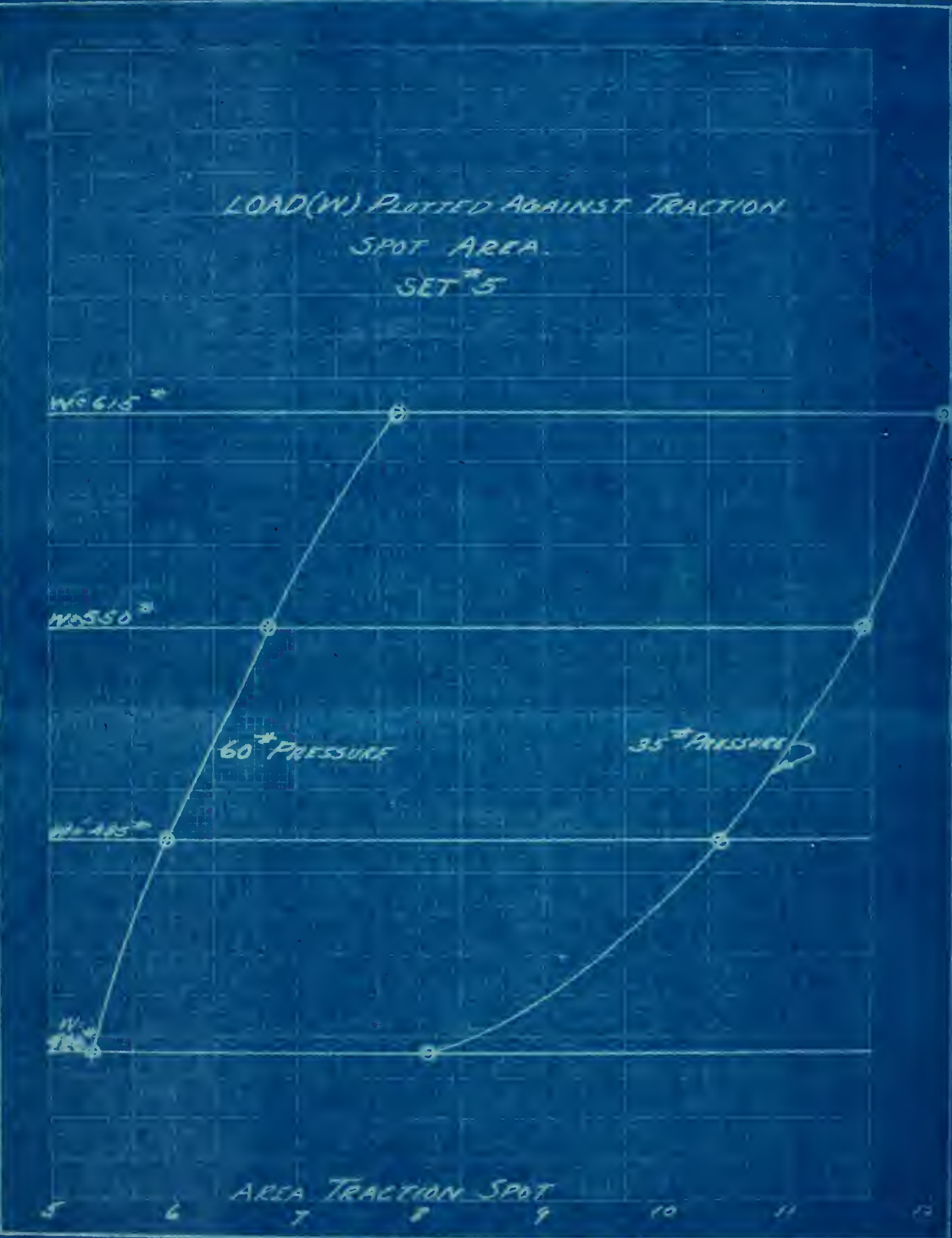



LOAD(W) - HEIGHT (H) CURVES
R.P.M. CONSTANT

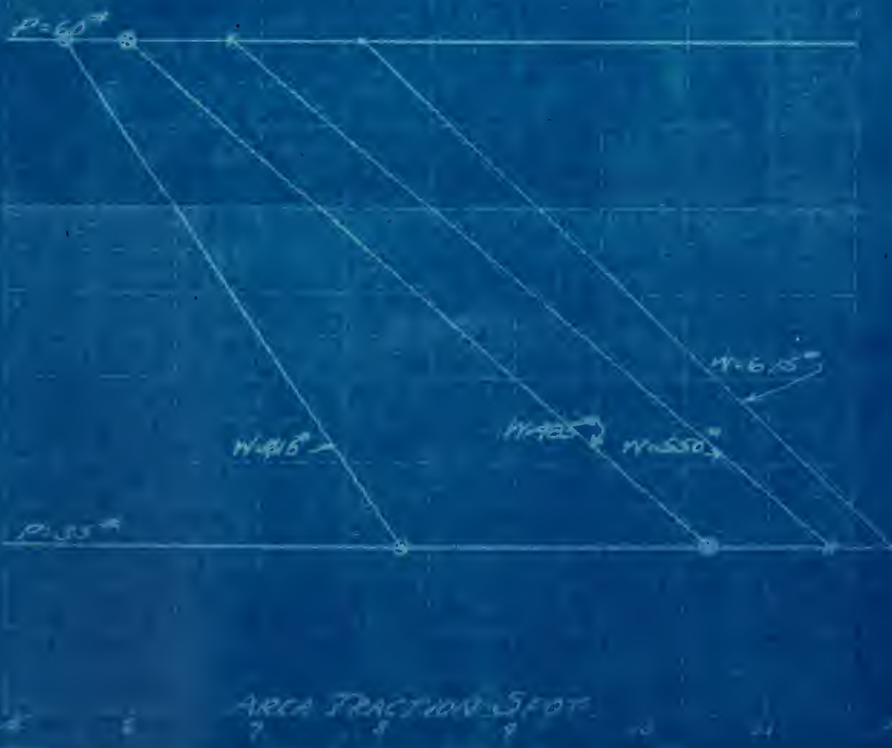

LOAD(W) - HEIGHT (H) CURVES
R.P.M. CONSTANT
SET #3
W=615#
W=550#
W=485#
W=420#
450 RPM
240 RPM
118 RPM
60# PRESSURE
HEIGHT (H)
.1
.2
.3
.4
.5
.6



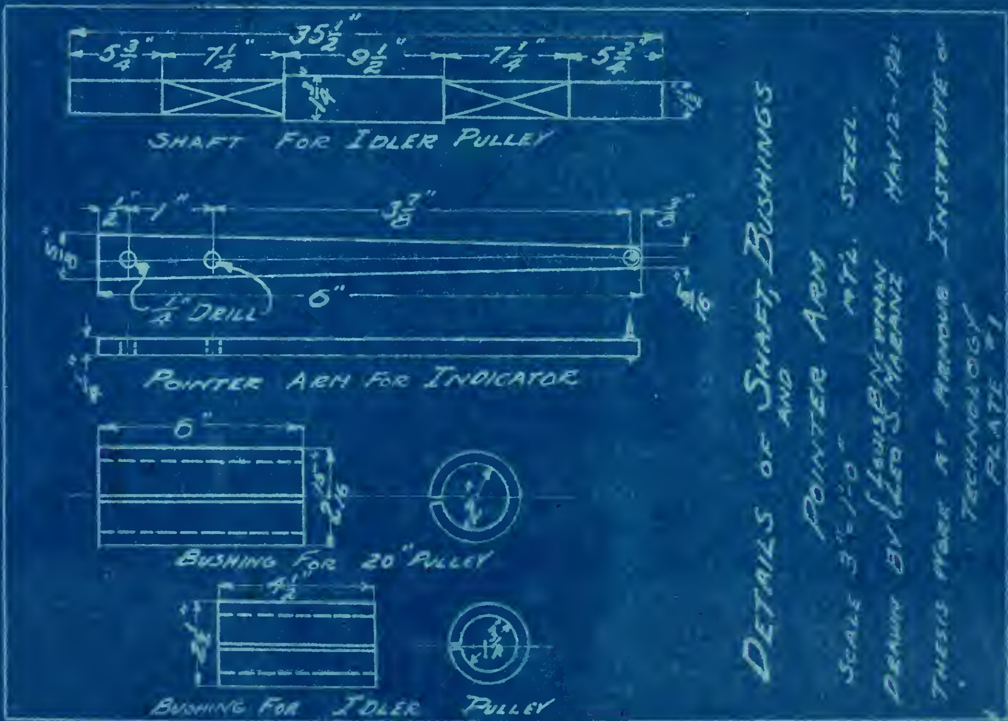
CURVES SHOWING CONSTANT
LOAD PLOTTED AGAINST
HEIGHT AND MILES PER HOUR.
SET #4
W=420#
W=550#
W=485#
W=615#
LOAD=20#
P=60#
HEIGHT (H)
MILES PER HOUR

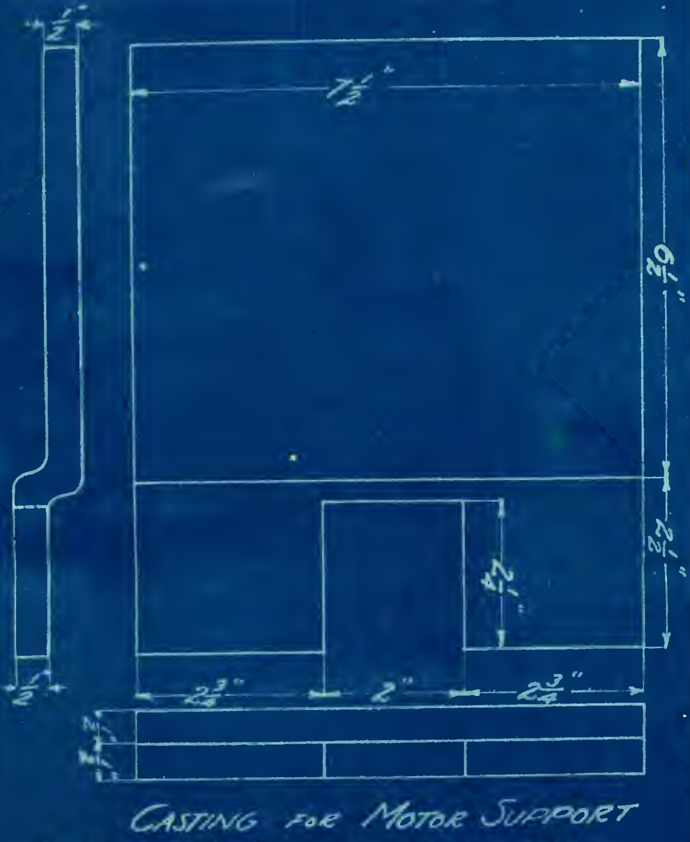

LOAD(W) PLOTTED AGAINST TRACTION
SPOT AREA.
SET # 5
W= 615 #
W= 550 #
W= 485 #
60 # PRESSURE
35 # PRESSURE
AREA TRACTION SPOT
5
6
7
8
9
10
11
12

LOAD - AREA OF TRACTION SPOT
CURVE
SET #6



DRAWINGS


35 1/2"
5 3/4"
7 1/4"
9 1/2"
7 1/4"
5 3/4"
SHAFT FOR IDLER PULLEY
1/2"
1"
3 7/8"
6"
1/4" DRILL
POINTER ARM FOR INDICATOR
6"
BUSHING FOR 20" PULLEY
4 1/2"
BUSHING FOR IDLER PULLEY
DETAILS OF SHAFT, BUSHINGS AND POINTER ARM
SCALE 3" = 1'-0"
MAT'L. STEEL
DRAWN BY LOUIS P. NEWMAN
LEO S. MARANZ
MAY 12 - 1921
THESIS WORK AT ARMOUR INSTITUTE OF TECHNOLOGY
PLATE #1



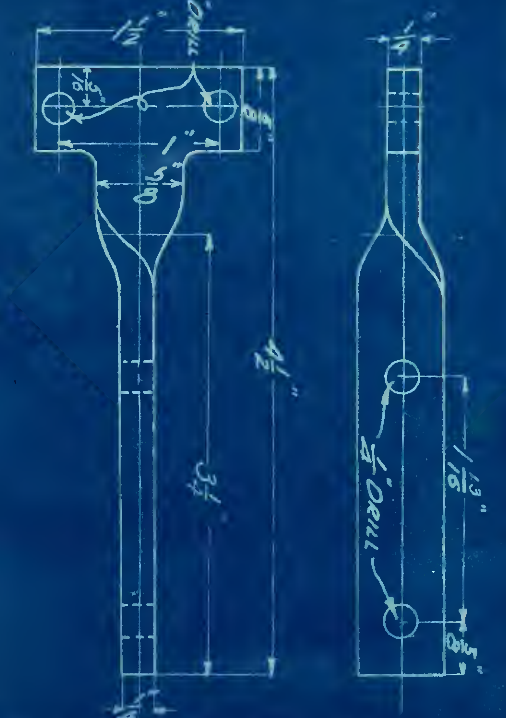
CASTING FOR MOTOR SUPPORT

Scale: 6" = 1'-0" M'T'L. CAST IRON

DRAWN BY { LEO S. MARANZ MAY 12-1921
 { LOUIS B. NEWMAN

THESIS WORK AT ARMOUR INSTITUTE OF TECHNOLOGY

PLATE #2



ARM SUPPORT FOR INDICATOR

SCALE 12" = 1'-0"   MT'L. C.R.S.

DRAWN BY { LOUIS B. NEWMAN / LEO S. MARANTZ

MAY 12 - 1921

THESIS WORK AT ARMOUR INSTITUTE OF TECHNOLOGY

PLATE

ANALYSIS OF CURVES AND DATA

ANALYSIS OF CURVES AND DATA

The curves and data can best be analysed from the graphs produced by plotting the various factors against each other with certain factors held constant

SET #1

On this graph the height H is plotted against the pressure P in the tire; the other factors being held constant.

The curves show that as the pressure in the tire is decreased the height H decreases. Since the shock absorption ability of the tire is universely as the height H; the curves show that the shock absorption increased with the decrease in pressure in the tire. This held true for speeds up to twenty-five miles per hour. Above this speed the shock absorption decreased with the decrease in pressure.

SET#2.

On this graph the height H is plotted against the load (W) on the tire, the other factors being held constant.

The curves show that up to about 500 pounds load on the tire when the tire was inflated to 60 pounds pressure, the

height H decreases and the load increases, which shows that the shock absorption is increased as the load increases up to the 500 pounds, and above this the shock absorption decreased with the increase in load (W). This is shown by the change in curvature of the lines.

SET#3.

This set is similar to Set #2, except that the pressure in the tire is 35 pounds instead of 60 pounds.

The curves show that up to about 500 pounds load on the tire having 35 pounds air pressure in it, the height H increases and the load increases, which shows that the shock absorption decreases with the increase in load up to 500 pounds, and above 500 pounds the shock absorption increases with the increase in load up to 615 pounds.

SET #4.

On this graph the height H is plotted against the speed of the tire in miles per hour.

The curves show that as the speed

increases the height H decreases, which shows that the shock absorption increases with the increase in speed up to about 30 miles per hour and with still increasing speeds the shock absorption begins to decrease.

SET #5.

On this graph the area of the traction spot is plotted against the load on the tire (W)

The curves show that as the load (W) on the tire increases the area of the traction spot increases. As the area is increased the rolling resistance is increased accordingly.

SET # 6.

On this graph the area of the traction spot is plotted against the pressure of the air in the tire (P).

The curves show that as the pressure of the air in the tire is decreased the area of the traction spot is increased and thereby the rolling resistance is increased accordingly.

SUGGESTED CHANGES

SUGGESTED CHANGES

In order to obtain better results and more exact data, the following suggestions if carried out will in all probabilities bring the desired results.

The recording apparatus as it is at present, has the motor directly connected by gears to the brass cylinder (E) as in Fig. 14. This means that whenever the motor rotates the paper must move and it thereby meant waiting for the motor to come to constant speed in order to have the paper move uniformly, which meant a waste of paper and of time. It is suggested that a clutch be installed between the motor and the cylinder (E), so that the motor can be running at constant speed, and that the clutch can then be engaged to give the cylinder immediate uniform motion. When the curve has been recorded for a sufficient length of time the clutch can be thrown out and the paper stopped at once.

A speed recorder should be attached to the recording device so that the speed of the paper can be obtained accurately at

any time during the run. It is desirable to know the speed of the paper in comparison to the speed of the bump and also in comparison with the speed of the tire.

Another suggested change is to move the idler pulley (K) back about four more feet making a total of ten feet from the brake. This is suggested, for at high speeds the bump came too often and the tire did not fully come to rest before the bump came around again. By moving the idler pulley (K) back this objection can be eliminated.

Another suggested change is to make the bumper pulley more rigid. The bumper pulley is set into vibration due to the shock of the tire. Its vibrations are also recorded on the chart giving inaccurate results. By using heavy inverted hangers a heavy shaft and heavy pulley this error can be eliminated.

It is hoped that with the fulfillment of the above suggestions, more complete and accurate data can be obtained.

CONCLUSION

CONCLUSION

The original idea of this treatise was to make comparitive tests and if possible to get some numerical data. Due to shortage of time no comparative tests were made between various tires. The results obtained were obtained from a standard U. S. Plain 30" x 3½" tire.

The tests were made using this tire under the various conditions as stated in a previous chapter and after a complete study and analysis of the data was made, the following conclusions were formed.

The amount of shock absorbed by a tire depended upon the speed of the tire, the load on the tire, the air pressure in the tire and the tractive effort produced by the tire.

It was found that at moderate speeds the shock absorption of the tire increased with the decrease of the air pressure in the tire, and that at high speeds the opposite took effect, that is, the shock absorption decreased with the decrease of the air pressure in the tire.

It was also noted that up to a certain load the shock absorption of the tire increased with the increase in load on the tire, and above this

load the shock absorption decreased with the further increase in load at high pressure in the tire.

Up to the same load as in the case when the pressure of the air in the tire was high, the shock absorption of the tire decreased with the increase in load and upon further increase of load the shock absorption was increased, this occurrance taking place with low pressure in the tire.

It was observed that at moderate speed the shock absorption of the tire increased with the increase in speed, and at high speeds the shock absorption decreased with the increase of speed.

As the tractive effort was increased and the traction spot increased in size with the increase in load on the tire and also with the decrease in pressure of the air in the tire.

It is hoped that with the suggested changes, more accurate and complete data will be obtained, and perhaps numerical data established.

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